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Railroad Forest Fire Protection

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RAILROAD FOREST FIRE PROTECTION

MINOR THESIS PRESENTED FOR THE

DEGREE

of

MASTER IN FORESTRY

by

J. D. Lamont

CORNELL UNIVERSITY

April - 1915.

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## Railroad Forest Fire Protection

The protection of our forests from fires caused by railroads forms one of the most difficult problems in forestry. This article will deal first with the state laws relative to railroad fires and secondly with the prevention and control of railroad forest fires.

### Part I.

#### Laws Relative to Railroad Forest Fires.

Twenty-six states besides the Dominion of Canada have laws in relation to railroad forest fire protection, and other states are trying to pass similar laws. A great deal of educational work must yet be done not only in those states which do not have railroad forest fire laws but also in those states which do have such laws. These laws are of little or no value unless there is some power which is strong enough to enforce them.

#### Damages

Railroad fires are usually a result of sparks or live coals escaping from locomotives. At least twelve states have statutory laws whereby a person can recover damages for forest property which has been injured or destroyed by a fire which was caused by a railroad. However, in other states, damages can be obtained by common law even though there are no statutory laws. The common

law maxim is that- "One must so use one's own (property) as not to injure another". Common law is a system of jurisprudence originating in custom or usage as distinguished from statutory law which is a legislative enactment duly sanctioned and authenticated,

Connecticut has a good law whereby damages can be recovered. It reads as follows: "When property is injured by fire communicated by an engine of a railroad company, without contributory negligence on the part of the person entitled to the care and possession of such property, such company shall be held responsible in damages to the extent of such injury to the person so injured." In contrast to this the Oregon law allows double damages in some cases. This law says: " In addition to the penalties provided in this act, the United States, state, county, or private owners, whose property is injured or destroyed by fires in violation of this act, may recover in a civil action double the amount of damages suffered if the fires occurred through willfulness, malice, or negligence; but if such fires were caused or escaped accidentally or unavoidably, civil action shall lie only for actual damage." The Wisconsin law also allows double damages. In some ways the New York law is even more definite than those already given. It says: "Any person who negligently suffers a fire to extend from his own lands to any other lands shall be liable to the state for any damages caused to state lands by such wrongful act. He shall also be liable to any person or municipality for actual damages caused to such person or municipality by



such wrongful act or to damages at the rate of one dollar for each tree so killed or destroyed. The state or a person or municipality so injured, however distant from the place where such fire was set or started and notwithstanding the same may have burned over and across several separate and distinct tracts, parcels or ownerships of land, may recover as aforesaid."

In many cases it is hard to prove that the railroad is responsible for fires which start on or near its right-of-way so that states are beginning to place the burden of proof on the company to show that it did not start the fire. The New York courts hold that a fire that starts on or spreads from the right-of-way of a railroad company is prima facie evidence of willful negligence on the part of the company. Except in a few states, the railroad is liable for damages even though it uses protective devices. Oregon and California give damages not only for the value of the property injured or destroyed but also for the injury to soil and vegetation. In Louisiana damages can be secured for injury to young growth; this damage is the cost of artificial planting and care of the trees to the age when the fire occurred.

#### Duties of Employees.

The employees of a railroad must cooperate with the company in the prevention and control of fires. They must be alert and do all in their power to keep down the number and size of fires. They should be made to realize

that the welfare of the company affects their employment. Many railroads have to pay thousands of dollars of damages every year because of the negligence of some of its employees. At least twelve states have laws which define the duties of employees of railroads. Employees must (1) do all in their power to prevent fires, (2) report fires as soon as discovered and (3) extinguish fires. The state or the railroad company should inflict a penalty upon the employee for neglect of duty in regard to railroad fires.

Massachusetts has a good law concerning the duties of railroad employees. It reads: "Any engineer, conductor or other employee on a train who discovers a fire burning uncontrolled on lands adjacent to the tracks shall forthwith cause a fire signal to be sounded from the engine, which shall consist of one long and three short whistle blasts repeated several times, and shall notify the next sectionmen whom the train passes, and the next telegraph station, of the existence and location of the fire. Sectionmen or other employees of a railroad who receive notice of the existence and location of a fire burning on land adjacent to the tracks shall forthwith proceed to the fire and shall use all reasonable efforts to extinguish it; provided, that they are not at the time employed in labors immediately necessary to the safety of the tracks or to the safety and convenience of passengers and the public. Railroad corporations shall inform their employees as to their duties under this act and shall furnish them with the appropriate facilities for reporting and extinguishing such fires." The New York law adds that "No corporation or

person or employee thereof shall deposit fire, coals or ashes on any railroad track or right-of-way near forest lands", and when a station agent has been notified of a fire, "such station agent shall forthwith notify the nearest fire warden or forest ranger of the fire".

Minnesota, New Hampshire, New York and Wisconsin have laws which require the railroads to employ inspectors whose duty it shall be to inspect the engines and right-of-way of the company at regular intervals and see that they are kept in order. Minnesota, New York, Washington, and Wisconsin employ state inspectors who must see that engines and rights-of-way are kept in order.

#### Protective Devices

Most of the railroad forest fires are caused by the escape of sparks from the smoke stacks, and the dropping of live coals from the ash pans upon the tracks. It is, therefore, imperative that these dangers be eliminated in one way or another. The best way, where practicable, is to use oil burners or electric power in the place of coal or wood in locomotives. If it is necessary to burn coal or wood, then the laws provide that adequate protective devices must be used to prevent the escape of sparks and live coals from the engines.

The Minnesota law says that "every company operating a railroad for any purpose shall equip and use upon each locomotive engine a practical and efficient ash pan and



Spark arresting hood used on the stacks of the locomotives on the Chicago, Milwaukee and St. Paul Railroad, - Wisconsin.



Train on heavy grade throwing out sparks. Danger of forest fires greatly lessened by burning over right-of-way. - Connecticut.

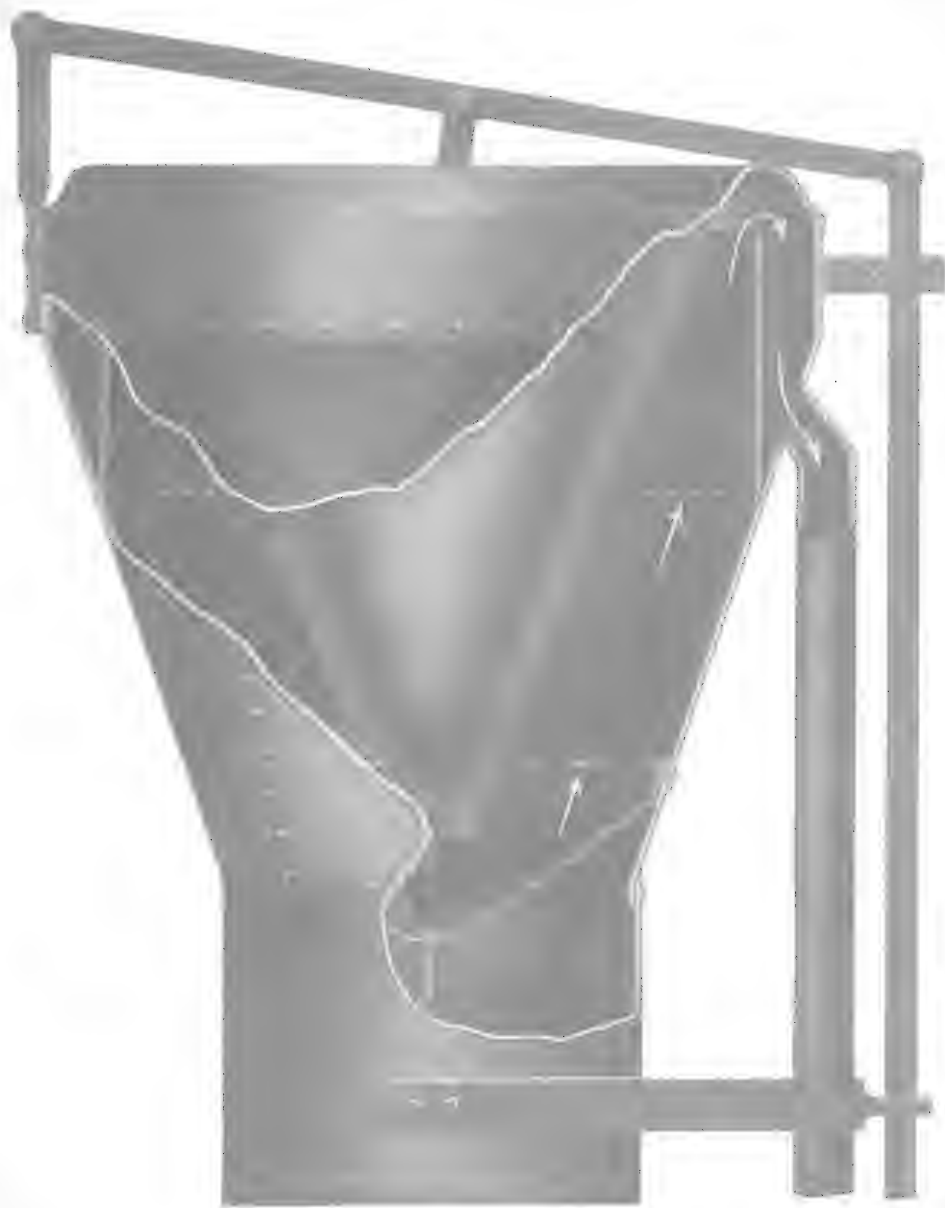
spark arresting device, which the master mechanic shall cause to be examined and the same shall be examined by the master mechanic or some employee each time before leaving the round house, except when snow is on the ground. A record shall be kept of such examinations in a book to be furnished by the railroad company for the purpose of showing;

1. The place and number of each engine inspected.
2. The date and hour of such inspection.
3. The condition of the said fire protective appliance and arrangements.
4. A record of repairs made to any of the fire protective appliances.

The said book to be open for inspection by the State Forester or other authorized officer appointed by him. The master mechanic or employee making such examination shall be held responsible for the good condition of the same, but without relieving the company from its responsibility hereunder."

As many as twenty-one states now require the railroads to use protective devices on their locomotives. In New York each locomotive must be inspected each time it leaves a division point or round-house between March first and December first to see that its protective devices are in good condition.

In New York the Public Service Commission upon the request of the Conservation Commission may require any railroad to adopt such devices and precautions against setting fires as the public interest demands. The Public Service Commission requires the railroads in the Forest Reserve in the Adirondacks to burn oil instead of coal between 8 A.M. and 8 P.M. during the danger season. Maine compels the railroads in



The South Bend Spark Arresters.

## PATENT BOOMERANG SPARK ARRESTER



Particular attention is called to our new Patent Boomerang Spark Arrester, with which all of our engines are equipped. The exhaust, which is the cause of so much trouble with the ordinary Spark Arrester, is made use of in the Boomerang Spark Arrester, and the heavier the draft, the better it works.

The sparks and smoke going through the stack are separated by a cone, which is a little larger in diameter at base than stack. The smoke, being light, takes the course of least resistance around the outer edge of cone and through screen. The sparks, on account of the momentum, travel straight up and are diverted by the solid steel cone into the boomerang and thence into screen conveyor tube into bucket or half barrel on roof or any convenient place.

Briefly stated, the merits claimed for the above Spark Arrester are as follows:  
Absolutely stops all sparks from passing out of stack.

It does not choke exhaust.

Will outlast other spark arresters.

Works equally well with wood or coal.

MADE IN ALL SIZES FOR DONKEYS AND LOCOMOTIVES.

Prices quoted on application.

Manufactured by **WASHINGTON IRON WORKS, Seattle, U.S.A.**

the forestry district to fasten down or screen the windows of smoking cars between May first and November 10, to prevent the throwing of lighted materials from the car.

### Right-of-Way

The condition of the right-of-way along a railroad has a great deal to do with the spreading of fires to adjacent lands. The purpose of the various state laws is to compel the railroads to keep their right-of-way in such good condition that there will be a minimum of danger from fires. Fifteen states now have laws which require that the right-of-way shall be kept cleared, and twelve states require that no deposits of live coals or hot ashes shall be left on the track near woodlands. The Wisconsin law says that "Every corporation maintaining and operating a railroad shall, at least once in each year, cut and burn or remove from its right-of-way all grass and weeds, and burn or remove therefrom all brush, logs, refuse material, and debris within a reasonable time, and whenever fires are set for such purpose, shall take proper care to prevent the escape thereof from the right-of-way. No such corporation shall permit its employees to deposit fire, live coals, or ashes upon their tracks outside of the yard limits except that they be immediately extinguished." Most states provide that railroad ties and material for shipment may be piled along the right-of-way. In Minnesota the State Forester may prohibit all burning along the railroad right-of-way during very dry and dangerous periods.





Right-of-way clearing along Grand Trunk Railway, Ontario. Note the large amount of inflammable debris which has been collected from the right-of-way and the narrow strip adjacent thereto. The railway company and the provincial government cooperated in the expense of this work which covered a strip outside the right-of-way through Algonquin Park. Both pictures.



### Fire Lines

Seven states at the present time have laws requiring the railroads to build fire lines along their right-of-way at danger points. However, in one of these states, New Jersey, the law has been declared unconstitutional. Fortunately this was not done until after most of the railroads had seen the good results which were obtained from the fire lines which were constructed soon after the law was enacted. The number of fires was very greatly decreased where there were fire lines so that now the railroads are continuing to build fire lines even though they are not compelled to do so, since the law was declared unconstitutional.

The purpose of these laws is to insure better protection to lands adjacent to the railroad right-of-way by constructing fire lines on these lands from one hundred to two hundred feet from the track. Usually the railroad must obtain permission of the abutter before it may make a fire line on his property.

The New Jersey law provided that through woodlands a strip ten feet wide must be cleared and plowed at a distance of not less than one hundred feet nor more than two hundred feet from the track. This strip must be kept cleared of all combustible material and the area between the track and the fire line must be burned or kept cleared of all dead wood, brush, grass, and leaves. Only one-fifth of the total length of the fire line was to be completed each year so that it would take at least five years



Beginning of fire line along railroad. Heartwood, N.Y.



Fire line parallel to track. Kept bare of vegetation by harrowing with yoke of oxen. Heartwood, New York.

to get a complete system of fire lines. However, one weakness of the law was that nothing could compel the owner to allow the building of these fire lines on his property.

The Minnesota law says that "Every railroad company shall establish and maintain such fire breaks along the route of its railway as can be constructed and maintained at not excessive expense. The intention shall be to adjust the protective measures to the local conditions, and to make the expense proportionate to the fire risk and the possible damage."

### Patrol

Eight states now have laws that provide that the railroads must maintain fire patrol for duty at critical points along their tracks during the danger season. The purpose of these patrols is to discover and extinguish fires as soon as possible after the fires start. Speeders are used a great deal in patrol. The Minnesota law requires that "When in the judgment of the State Forester there is danger of the setting and spreading of fires from locomotive engines, he shall order any railroad company to provide patrolmen to follow each train throughout such fire patrol district or districts as he deems necessary to prevent fires, ..... and upon its failure to do so, the State Forester may employ patrolmen with the necessary equipment to patrol the rights-of way of said railroad, and the expense of the same shall be charged to the said railroad company, and may be recovered in a civil action in the name



Fire fighting car used for patrol in the dangerous season on the Wharton and Northern Railroad. New Jersey, 1911.



Speeder used by railroad patrolmen. Minnesota.



of the State of Minnesota." Wisconsin, Maine and New York have similar laws. New Hampshire, West Virginia, Pennsylvania and Washington require patrols but cannot establish them at the expense of the railroad. In Washington the patrols start to follow logging engines about thirty minutes after they leave.

### Control

Railroads must furnish means and facilities for fighting fires near their right-of-way. The methods of fighting fire have to be worked out for the conditions which exist in each particular region. Methods best adapted to the specific conditions should be used. The laws are broad and do not specify the means of extinguishing fires. The Minnesota law requires that "Every railroad shall give its employees particular instructions for the prevention and extinguishment of fires, and shall cause warning placards such as are approved by the State Forester, to be conspicuously posted at every station in the vicinity of forest, brush, and grass lands, and when a fire occurs on the right-of-way of its road, shall immediately concentrate such help and adopt such measures as shall be available for its extinguishment". Other states have laws very similar to the one in Minnesota.

### Expenses of Extinguishing

There are ten states which have laws which require the railroads to pay the expenses of extinguishing fires which originate along the right-of-way. The cost of fighting fires is a big expense so that if the railroads realize



Inflammable debris on Grand Trunk right-of-way, Ontario. The fire hazard is very materially increased by the presence of this debris.



that they must pay this in addition to the damages, they will exert even greater efforts in preventing fires. The Connecticut law says that "Any railroad company which, through any act of its employees or agents, by sparks from its locomotives, or otherwise, sets fire to trees, brush, or grass on lands outside the right-of-way of such company shall be liable to the town or city in which such fire occurs for the lawful expenses incurred by such town or city in extinguishing such fire." The Massachusetts law is almost identical with the Connecticut law. The West Virginia law provides that the railroad shall pay the costs of extinguishing but that "the same shall not bar the rights of damage between the parties thereto".

#### Fire Insurance

Five states have laws which give the railroad the right to secure insurance on property adjoining the right-of-way which is liable to be damaged by fires caused by the railroad. If the railroad is held responsible for damages, then it should have an insurable interest in property which, because of its dangerous location, is subject to railroad fires. The Massachusetts law says that "The railroad shall have an insurable interest in the property upon its route for which it may be held liable for damages, and may procure insurance thereon in its own behalf. If it is held liable in damages, it shall be entitled to the benefit of any insurance effected upon such property by the owner thereof, less the cost of premium and expense of recovery. The money received as insurance shall be deducted from the dam-



Brush, grass and weeds, along Quebec and Lake St. John Railway, in the province of Quebec. This material should be cut, piled and burned, under careful supervision. Note the pile of old ties ready for burning.



Brush, grass and weeds, along Quebec and Lake St. John Railway, in the province of Quebec. This material should be cut, piled and burned, under careful supervision. Note the pile of old ties ready for burning.

ages, if recovered before they are assessed; and if not so recovered, the policy of insurance shall be assigned to the corporation which is held liable in damages, and it may maintain an action thereon". Connecticut, New Hampshire, Vermont and Wisconsin have each a shorter law which gives the railroad an insurable interest so that the railroad may secure insurance for its protection against damages.

### Penalties

It is difficult to enforce a law if there is no penalty incurred if the law is violated. A law is of no use unless it can be enforced. Therefore there should be a penalty for the violation of any law. The penalty should be neither too severe nor too light. Judgment must be used in specifying the degree of the penalty. The penalty must be severe enough so that it will not be cheaper to violate the law and pay the penalty than to observe the law. A judgment on a civil action to recover damages is no defense under a criminal prosecution to inflict a penalty.

The Minnesota law requires that "Any company or corporation violating any provision of this section (14) shall be deemed guilty of a misdemeanor, and on conviction thereof shall be fined not less than fifty dollars and not exceeding one hundred dollars and costs of prosecution for each offense and any railroad employee or other individual violating the same shall be guilty of a misdemeanor, and shall be punished by a fine of not less than twenty-five

## WILLAMETTE IRON AND STEEL WORKS

### SEQUOIA SPARK ARRESTER



**EXTERIOR APPEARANCE**  
Showing Arrester Mounted on Donkey Stack

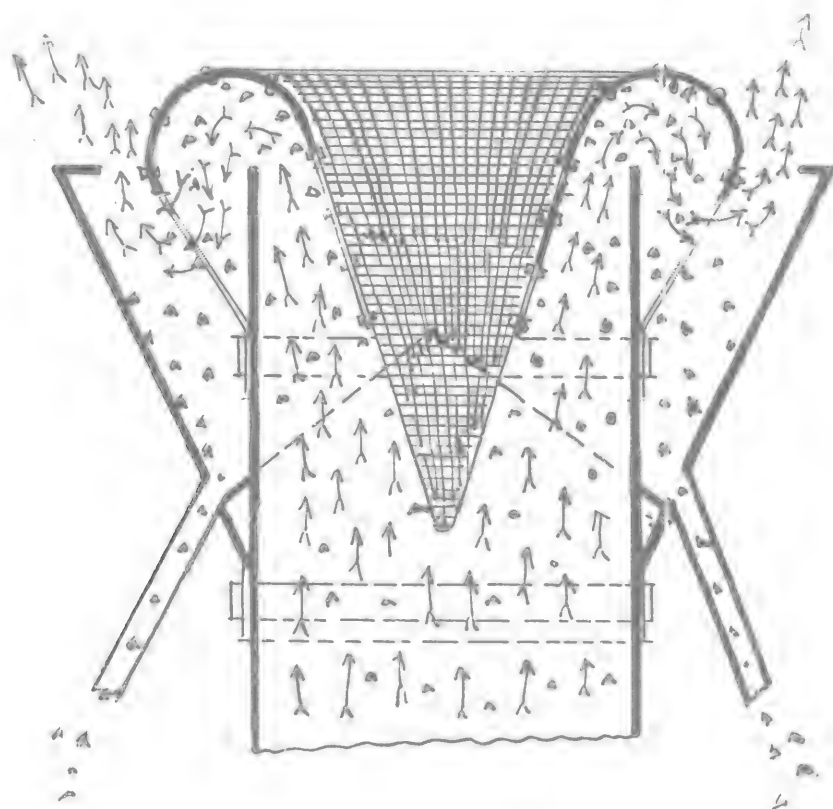
Figure No. 2 shows a cross section through the center of the stack, which clearly illustrates how the draft is unimpeded even though the screen becomes entirely clogged. The clearance around the screen is equal to the area of the stack, hence the area of exhaust is never contracted. The sparks are deflected down into the pan and thence led off to some convenient point through the outlet pipes.

The advantages are readily appreciated by all firemen and engineers. Special circular furnished on request.

This Arrester is guaranteed the most efficient spark catcher built. It is light weight, projects above the stack but six inches, and readily put on or taken off. Made for any size stack and adapted for use on logging and hoisting engines, locomotives, mill stacks, steamboats, etc.

#### NET PRICE LIST

For stack less than 12-inch diameter . . . . .	\$22.50
For stack from 12-inch to 17-inch diameter . . . . .	27.50
For stack from 18-inch to 23-inch diameter . . . . .	35.00
For stack from 24-inch to 27-inch diameter . . . . .	45.00
For stack from 28-inch and above . . . . .	Special Price



NO 2

dollars or more than one hundred dollars and costs of prosecution, or by imprisonment in the county jail not exceeding ninety days."

The Wisconsin law provides for "a fine of not less than fifty nor more than five hundred dollars, or by imprisonment in the county jail not exceeding one year, or by both such fine and imprisonment." The New York law says that "said company shall be liable to a penalty of one hundred dollars for each violation of the provisions of this section (101); and every day such railroad shall fail to maintain the patrol required by this section shall be deemed a separate violation."

# Railroad Forest Fire Protection Laws

States	: Spark	: Ash:	State	: R. R.	: Right-: Live
	: Arrester;	Pan:	Inspector:	Inspector:	: of- : Dep
	:	:	:	:	: Way* :
Alabama	: X	:	:	:	:
California	: X	: X	:	:	:
Colorado	: X <sup>1</sup>	:	:	:	: X :
Connecticut	:	:	:	:	:
Delaware	: X	: X	:	:	:
Idaho	: X	:	:	:	: X :
Kentucky	: X	: X	:	:	: X :
Louisiana	:	:	:	:	: X :
Maine	: X	:	:	:	: X :
Maryland	: X	: X	:	:	:
Massachusetts:	X	: X	:	:	: X :
Michigan	: X	:	:	:	: X :
Minnesota	: X	: X	: X	: X	: X :
Montana	:	:	:	:	: X :
N. Hampshire	: X	: X	:	: X	:
New Jersey	:	:	:	:	: X :
New York	: X	: X	: X	: X	: X :
Ohio	: X <sup>2</sup>	:	:	:	: X :
Oregon	: X	:	:	:	: X :
Pennsylvania	: X	: X	:	:	: X :
Rhode Island	:	:	:	:	:
South Dakota	:	:	:	:	:
Tennessee	: X	:	:	:	:
Vermont	:	:	:	:	:
Washington	: X	: X	: X	:	: X :
West Virginia:	X	: X	:	:	: X :
Wisconsin	: X	: X	: X	: X	: X :
Virginia	: X	: X	:	:	: X :

\* Virginia, Kentucky, Ohio, Illinois and Missouri require cleaning of the right-of-way throughout its entire length. While one prevention of forest fires is not specified, is nevertheless implied.

1 Spark arresters not specified but implied.

2 Required in all locations; forest fire prevention, although not specified is implied.

Patrol	Expenses of	Insurance	Damages	Penalties	Duties of
	Extinguishing				Employees
	X				
			X	X	
	X	X	X		X
	X				
					X
	X		X	X	
					X
X					X
	X			X	
	X	X	X	X	X
				X	X
X	X		X	X	X
X	X	X	X		X
			X	X	
X			X	X	X
	X		X	X	X
				X	X
		X	X	X	X
X				X	
X	X		X	X	X
X	X	X	X	X	X



## Part II

### Prevention and Control of Railroad Forest Fires

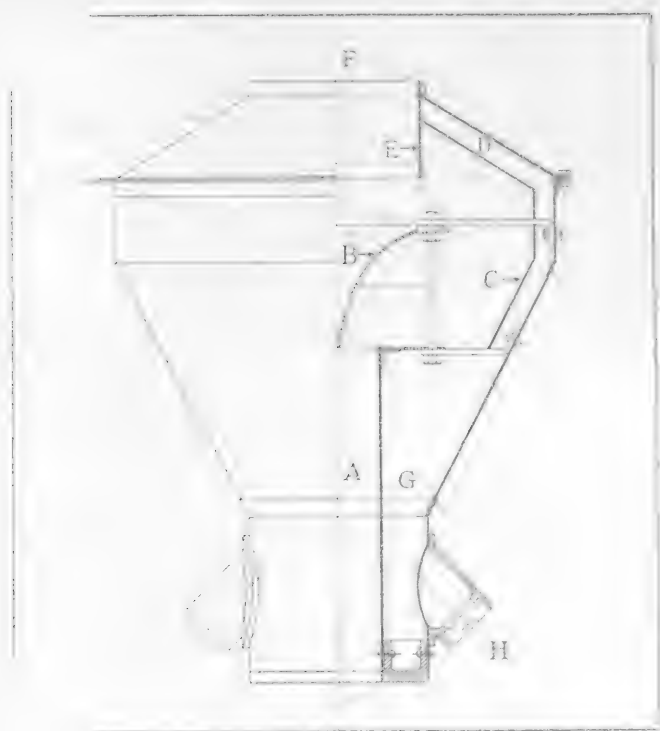
The prevention and control of railroad forest fires forms one of the hard problems which the railroads and foresters are trying to solve. Many railroads are doing everything in their power to eliminate forest fires which originate on their right-of-way. They are beginning to believe the old saying that "An ounce of prevention is worth a pound of cure".

#### Spark Arresters and Ash Pans.

Sparks from locomotives cause most of the fires which escape from the railroad right-of-way to adjacent forest lands. It is therefore necessary to use some kind of a device which will prevent the live sparks from escaping and falling on the right-of-way. Many different types of spark arresters are made but none has yet been designed which will stop all the sparks. Some of the best will stop at least 95 per cent of the sparks.

Allen (1911) says, "The argument that spark arresters prevent draft is not worth attention. It is greatly exaggerated by engineers and firemen prejudiced against innovation or too inattentive to keep their fires up properly and consequently unnecessarily dependent on occasional forced draft. The slight disadvantage involved in the modern improved arrester is not to be compared with the importance of the safety acquired."

There are two general types of spark arresters: (1) the "hood" type which is fitted on top of the smoke stack, and



- A Main Smoke Chamber
- B Cone with Spiral Veins
- C Perforated Screen Plate
- D Spark Chamber
- E Netting
- F Top Opening Stack
- G Cinder Receptacle
- H Cleaning Out Holes

### Description of the Action of the Lima R & H Diamond Stack

The action of the smoke and exhaust passes up through the Main Smoke Chamber "A" striking against the Spiral Cone "B" which gives it a whirling motion and the larger cinders are thrown outward by centrifugal force against the perforated Screen Plate "C". This plate has openings in it large enough to permit the passage of sparks; after the sparks pass through this perforated screen plate, they pass beyond the line of active draft and by their weight fall into the cinder receptacle "G". The lighter sparks which are not thrown through the perforated screen plate are carried by the draft against the fine netting "E". In firing up, the natural draft through "A" around "B" and under "E" is unobstructed by any netting. This has two advantages; one being that the possibility of clogging is eliminated and the other being that you get an easy, free draft when starting fire.

Practically, this stack is a centrifugal separator which prevents the emission of the larger and more dangerous sparks and allows only the small light sparks to escape, which are incapable of carrying fire by the time they leave the stack. The sparks are quenched by the grinding action against the screen plate by the centrifugal whirl imparted by the spiral veins on the cone.

The Lima R & H Stack has been an unqualified success. The Lima Locomotive & Machine Co. first started to equip locomotives with this stack in 1905 and since then have furnished over One Hundred Locomotives fitted with same.

The Washington Forest Fire Association, after investigating the merits of this stack recommended it to the loggers in the State of Washington and it has been favorably considered by Forest Fire Associations in other States. The following is a partial list of users of locomotives equipped with the Lima R & H Stack



SHAY GEARED LOCOMOTIVE FITTED WITH "LIMA R & H STACK"

(2) the "front end" type which fits into the front end of the engine.

The New York Public Service Commission has issued the following regulations concerning spark arresters for coal burning locomotives in use in the Adirondack Forest Preserve: "Screen to be of square mesh wire netting, or its equivalent, with opening not exceeding the opening in wire netting  $2\frac{1}{2}$  meshes per lineal inch in both directions, made of wire not less than .135 inches in diameter.

No opening will be permitted at any place inside of ~~extension~~ front which is larger than the maximum opening specified for wire netting. All joints must be substantially made and reinforced to prevent strands of wire netting becoming loose and forming larger than normal openings.

Particular attention must be given to the fit of spark arrester and plates around steam pipes, exhaust pipe, blower pipes and air pump exhaust pipe (when same is located in extension front).

The man hole door must have a substantial rigid frame and must be properly fitted and fastened against the main plate of spark arrester.

Particular attention must be given to the fit of plates against the flue sheet.

No openings will be permitted between top of diaphragm and the front of flue sheet, this joint to be protected by an angle iron of reinforcement."

Ash pans of engines should be so constructed that they will not drop fire upon the tracks. Exhaust pipes should empty into the ash pan so as to extinguish all fire



Right-of-way clearing along Grand Trunk Railway, Ontario. Note the large amount of inflammable debris which has been collected from the right-of-way and the narrow strip adjacent thereto. The railway company and the provincial government cooperated in the expense of this work which covered a strip outside the right-of-way through Algonquin Park. Both pictures.



there. Ash pans are liable to warp so that precautions must be taken to prevent any large openings from being formed.

Locomotives should be inspected every day, except when there is snow on the ground, to see that the spark arresters and ash pans are in good condition. This work should be done by an inspector employed by the railroad. It should also be his duty to make out and send a report each week to the State Forester showing the condition of the engines examined. There should also be a state inspector to inspect the work of the railroad inspectors.

The "hood" spark arresters and ash pans can be examined while the locomotive is in use but in order to inspect the "front end" arrester the engine must be cooled.

### Right-of-Way

Since spark arresters will not stop all the sparks, the right -of-way must be kept in such a condition that sparks will not set fire to it. Old stumps, logs, brush and other debris on the right-of-way should be removed or piled and burned at the time of the railroad construction. Then each year in the spring and in the fall the brush, grass, and weeds should be burned. Old railroad ties which are not removed should be piled and burned. Ties and other materials which are to be used in construction work should be safe guarded by clearing a strip three or four feet wide around each pile. Extreme care must be taken not to let the fires escape to adjoining lands. When the wind is blowing towards the track a man can walk along the outer side of the right-of-way with a torch and set fire to the grass. Another man



Portion of railroad right-of-way showing brush, grass and weeds, which need cutting. Note the old style method of clearing right-of-way by piling logs and inflammable debris along the outer edge of right-of-way parallel to the track at a distance of about fifty feet. All this debris should be burned under careful supervision. Grand Trunk Railway. Ontario. This work now done.



can follow back of him and prevent any fire from escaping to other property. Special care must be taken to keep the right-of-way cleared on up grades where the locomotives throw out more sparks on account of the forced draft, and also in deep cuts where debris on the high banks is very liable to catch fire. In New Hampshire there is a law which requires that timber operators must do their part by removing slash at least twenty-five feet from a railroad right-of-way.

Ryder (1912) says, "The people who do not clear their land next to the right-of-way can be divided into three classes:

1. Those who are indifferent.
2. Those whose intentions are good but who neglect.
3. Those who hope a fire will happen and the railroad be obliged to pay damages."

In the Black Forest in Germany maple and locust trees are planted on the right-of-way of the railroads to prevent sparks from setting fires. The leaves and brush from these trees are cleared out twice a year.

The railroads rightly claim that they do not start all the fires that occur on their right-of-way. Tramps and people walking along the tracks probably start some fires. A remedy for this is to stop track walking as far as possible. Matches, cigarettes, cigars, and contents of pipes thrown from smoking car windows are also responsible for some fires. Some of the railroads have stopped this by putting screens on the smoking car windows. Other railroads have put up signs in the cars requesting the passengers not to throw lighted materials from the train.





Inflammable debris on Grand Trunk right-of-way, Ontario. This is on a ridge which dries out early in the spring and becomes highly inflammable. The train runs through a cut which brings the stack nearly level with the ridge, thus increasing the danger of fire from sparks. Cleaned up later by the railroad company.

Railroad rights-of way can usually be kept cleaned and burned at a cost far less than the resulting cost of damages from fires which result if the right-of-way is not cleaned.

### Fire Lines

Fire lines are necessary if all railroad forest fires are to be eliminated. It is very rarely that a fire will get over a well constructed fire line. From careful observations it has been found that most of the sparks, and especially the larger ones, fall between thirty-five and one hundred feet from the center of the track, and that 95 per cent of all railroad fires originate within one hundred feet of the track. It is therefore plain to see that a one hundred foot right-of-way (i.e., fifty feet from the center of the track on each side) is not wide enough to catch all of the sparks. An additional fifty feet on each side of the right-of-way should also be cleaned and all brush, dead logs, grass and debris burned. The trees which are three inches in diameter and six feet apart do not have to be removed - in fact they aid in deadening the sparks before they reach the ground. Along the outer edge of this cleared strip a fire line ten feet wide should be plowed and then harrowed each year to prevent it from being over grown with grass, weeds or brush.

Although the New Jersey fire line law has been declared unconstitutional, several of the railroads continue to build fire lines for they have seen the advantage of them. The following diagram shows the construction of a New Jersey fire line.



Pennsylvania Railroad fire line east of Brown Mills  
Junction, New Jersey. 1910.

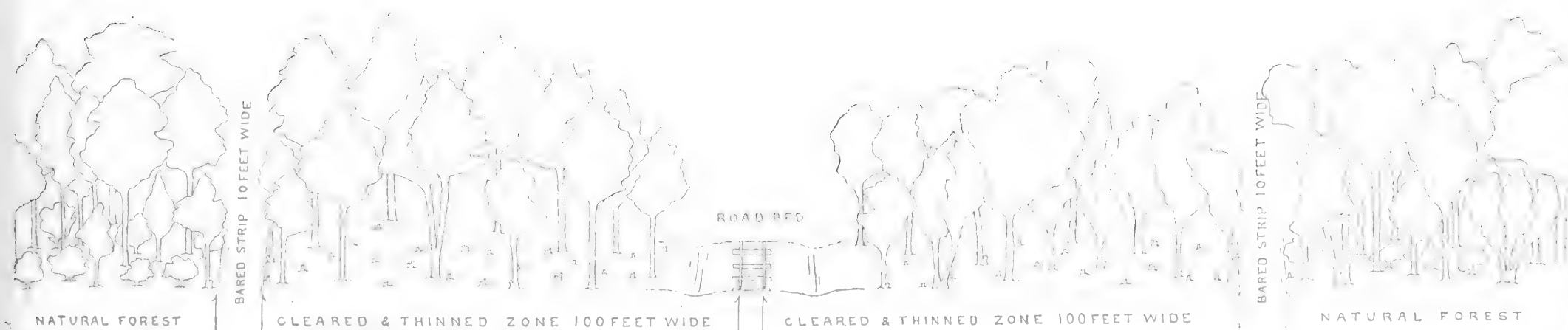


FIG. 4.—DIAGRAM OF RAILROAD FIRE LINE CONSTRUCTED ON LEVEL GROUND ACCORDING TO CHAPTER 74, LAWS OF 1909.

Gaskill (1909) says "A fire line like this is supposed to work thus: If a spark is thrown from the locomotive stack, the foliage of the trees may so retard its fall that its fire is lost. If a spark is not so killed and reaches the ground alive, it is almost sure to fall within the bared strip. There it finds little to burn, but if some grass or dry leaves are ignited the fire can gain little force or headway before it reaches the bared strip."

In swampy land a three foot ditch will take the place of the ten foot cleared fire line.

The railroads in New Jersey reported that fire lines cost between \$125.00 - \$500.00 per mile to construct with an average of \$180.00 per mile. Of course the cost depends upon the topography, nature of the ground, density of timber, labor, and the like. The superintendent of the New Jersey Southern Railroad wrote that the number of fires had decreased at least one hundred per cent since the fire lines were established. The annual upkeep of the fire lines was \$50 - \$75 and this becomes less each year.

Some of the railroads take the stand that the

abutters along a line should do their part and clear their lands for a distance of one hundred feet from the railroad.

The railroad should employ an inspector to see that its right-of-way and fire lines are kept in good condition, and see to it that new fire lines are built where necessary.

### Patrol

A railroad which uses spark arresters, keeps its right-of-way cleaned and has an adequate amount of good fire lines, does not need to patrol its lines except in dry seasons or on especially dangerous locations such as on heavy grades. But for the railroad which does not use all of these precautions it is very essential that an intensive system of patrol is used. A patrolman can cover from three to twenty miles of track depending on the condition of the right-of-way, the amount of traffic, and the grade. In very bad places it is often advisable to have one man patrol not over a mile at the most.

Patrolmen should be equipped with a velocipede or preferably a speeder car with gasoline power. He can cover on an average ten miles per hour. His fire fighting equipment will depend somewhat upon the region but it should usually include an axe, mattock, shovel, rake, chemical extinguisher, a collapsible canvas bucket and a water pot sprinkler. In some regions where there is a telephone line along the right-of-way, it would be well for the patrolman to carry a telephone test set so that he could call for assistance if he needed it. A patrolman should make at least





SPEEDER CAR WITH FIRE FIGHTING EQUIPMENT.  
Used for railroad patrol by the Boston & Maine R. R.



Fire tool box and equipment.      New Hampshire.

two round trips over his beat every day and in especially dry seasons it is often necessary to follow a few minutes after each train. If he follows too closely after a train he may pass some sparks which have not had time to ignite and send up any smoke.

The Laquire Lumber Company in Pennsylvania stationed patrols along the logging railroad at one half mile (or even less) intervals where there was especial danger, as near slashings, or at intervals of a mile where the danger was less.

In 1910 in District I, of the United States Forest Service, the wisdom of an intensive railroad patrol was demonstrated by the season's showing of over 95 per cent of the 1300 railroad fires extinguished without damage. No other expenditure for protective work netted an equal return in actual results.

The railroads must patrol their lines without the aid of federal patrolmen who are furnished to the states under the Weeks law.

On the Maine Central Railroad in New Hampshire, one man is detailed from each section crew to patrol the track during dry weather. He is provided with a velocipede and carries a shovel, hoe, and pail.

Cox (1915) says, "In a few instances on the smaller roads, where there are only two or three trains a day, the system of following each train was used. This method is very satisfactory where the conditions are not too bad. Where conditions are dangerous, it is open to the objection that if an engine running over the road set several fires at considerable distances apart, the last fire set might gain dangerous





Fire line along Atlantic City Railroad, Brigantine Junction, New Jersey. The white streak on either side is the bared ten foot strip at the outer edge of the fire line. 1910.

headway before the patrolman, delayed by putting out fires previously set, could get to it. A better plan is to have a member of the section crew follow the train to the next section, and so on over the line. Under this arrangement it is possible that several section men along different points of the line would be fighting fire at the same time."

In Minnesota the patrolmen make out daily report cards in duplicate, one going to a railroad official and the other to the district ranger. The following is a copy of the report card:

Patrolman \_\_\_\_\_

Date \_\_\_\_\_, 1915.

Time started work \_\_\_\_\_ Time quit work \_\_\_\_\_

No. of trips made over beat \_\_\_\_\_

Nature of work done during day.

From .....To..... From..... To..... From..... To.....

Time met: train	No. of engine	:	Direction	:	Mile Post	:	Direction of wind	:	Weather Conditions
:	:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:	:

Cox (1914) says, "The total mileage of track protected by speeder men following each train was 177 miles; by patrolling a regular beat with speeder, 2016 miles; - requiring in all 182 men. A total of 127 miles was protected by foot patrol, requiring 42 men. The average beat for the speeders was twelve miles, and for the foot patrol three miles."



Fire line along Atlantic City Railroad, Brigantine Junction, New Jersey. Bared strip on the left of fire line and railroad on the right. 1910.

Train crews should keep a sharp lookout for fires and when one is seen they should report it to the first section crew the train passes or to the next station.

### Oil as Locomotive Fuel

Absolutely the best method of preventing railroad forest fires is to use oil fuel for locomotives during the danger season. Electric drive has been used very little except for interurban lines. Experience has shown that oil locomotives very rarely start forest fires.

The following is a note from American Forestry for February 1915: A small railroad operating an oil burning locomotive on the Tahoe Nation Forest in California had a break down during the past summer and burned wood instead of oil for one day. On this day fifteen fires started along the right-of-way. During the preceding year only one fire occurred near the railroad and it was not thought that the engine was responsible for this one.

Allen (1911) says, "Much data has been collected showing that with oil at a reasonable price its use is economical from a labor saving point of view as well as that from safety. It reduces expense for watchman, patrol, fuel cutting, fire box cleaning and firing. And since it is an absolute prevention, while all other measures merely seek to minimize the risk, it is probable that even where the cost of the oil more than balances these savings it will save in the long run by averting a costly fire."

The largest oil fields in the country are in southern



Plowed fire line 100 feet from railroad track. at right. - Connecticut.



Clearing along railroad right-of-way. - Minnesota.



California. Little coal is mined on the Pacific coast so that oil makes the cheapest fuel to use in that region. Oil has almost entirely replaced coal for locomotive fuel in Washington, Oregon, California, Nevada and Western Arizona. But in other parts of the country fuel oil is more expensive than coal. In a number of cases the United States Forest Service requires that the railroads which cross the National Forests must burn oil for fuel. The Southern Pacific Railroad is the largest consumer of fuel oil.

The New York State Public Service Commission requires that the New York Central and the Delaware and Hudson Railroads burn oil from 8:00 A.M. to 8:00 P.M. from April 15 to November 1, in the Adirondack region. Previous to this order of the Commission, the only railroad in the Adirondacks which was free from fire complaints was the Racquette Lake Railroad. This was due to the fact that fuel oil was burned during the summer. The average cost of changing engines from coal to oil burners was \$530, and the cost of changing back to coal was \$25.

Bristol (1912) says, "The cost of burning coal per engine mile in 1910 on the Delaware and Hudson Railroad was \$.1046 as against \$.2823 for oil ; and in 1911, \$.1174 as against \$.2521, or an increase per engine mile due to the burning of oil in 1910 of \$.1777 and 1911 an increase of \$.1347."

The Delaware and Hudson Company says that fuel oil as a fire preventative measure is very satisfactory but it is too expensive ; that with a great deal less expense a patrol



Fire line on Lehigh Valley Railroad near Bloomsbury, New Jersey. Bared ten foot strip is in the center of picture. The thinned and burned over fire line is at the right of the strip and the railroad is at the extreme right. 1910.



A fire line on swamp ground. A three foot ditch takes the place of the ten foot cleared strip which is required for dry ground. On West Shore Railroad. 1910. New Jersey.



system could be maintained which would be just as effective; and that the added expense of fuel oil is too much for a small company.

The New York Central Railroad Company says that oil costs 80 per cent more than coal and that they have not done away with the other protective measures.

But in all cases the fire damages are a great deal less where fuel oil is used, but the constantly increasing price of fuel oil is seriously retarding the movement toward its more general use by railways.

Leavitt (1912) says, "Even with the best use of oil-burning appliances, there will still be danger of fire along railroad lines, due (a) to carelessness by passengers or others in throwing burning cigars or cigarettes on the right-of-way; (b) To careless or malicious action by tramps, or other pedestrians, in leaving camp fires burning along right-of-way; (c) To carelessness of section men.

In general, the establishment of a special system of fire patrols may be dispensed with along railroad lines where oil is used as locomotive fuel. The removal of inflammable material from the right-of-way is essential, even in oil burning sections, on account of the possibility of fires from causes other than locomotive operation. The great increase in oil-burning mileage on railways is due primarily to the fact that a saving can thus be made in operating expenses. Fire prevention has in general been a secondary consideration, except in case of a requirement for the use of oil being made by some government authority."



Fire line which is also used as a road. Railroad at the right of picture. Wisconsin.



Fire line of the Concord Electric Company. New Hampshire.

### Fire Fighting Equipment

As long as there remains any danger from railroad forest fires adequate provision must be made for the fighting of such fires. Plenty of tools of the right kind should be kept at the section houses or depots.

The following is the special price list of forest fire tools and apparatus which may be purchased through the New Hampshire Forestry Commission :

Handled axes - - - - -	\$9.00 per dozen		
Long handled shovels - - - - -	6.00	"	"
Forged steel rakes, 14-teeth, electric welded - - - - -	2.93	"	"
Ely socket hoes - - - - -	4.36	"	"
Galvanized pails, 12 qt. medium - - -	1.65	"	"
" " " " heavy - - -	2.75	"	"
Grub hoes - - - - -	3.50	"	"
Pick handles #1 - - - - -	1.75	"	"
Pick handles #2 - - - - -	1.50	"	"
Chemical extinguishers, -3 gallons----	6.50 each		
Douglas pump - - - - -	3.50 each		
" double pump - - - - -	8.50 each		

Wet gunny sacks are also valuable sometimes in beating out fires. Any or all of these different articles can also be carried by a patrolman on his gasoline speeder.

In case of large fires the railroad should have ready access to supplies of food, cooking utensils, and blankets. When more help is needed, besides the section



Fighting a hot fire in grass with a two man pump.  
Connecticut.



Putting out a grass fire with ordinary bucket pump  
especially adapted to the purpose. Connecticut.

and construction crews to fight fire, the railroad should know where it can quickly get the men if it does not rely on the district ranger for extra help.

Chemical extinguishers are a great help in putting out railroad fires. They are easily transported by rail.

Many logging engines are equipped with a one inch hose from 50 - 100 feet long. By using some of the water in the tank, the engine can force water through the hose and put out small fires along the railroad.

Recknagel (1906) gives the following description of a tank car used for fire fighting: "On a convenient siding stands an old tank car of 4970 gallon capacity, rigged with a hose and double pump. This is the company's fire engine. This tank car was obtained from the Mitschkun Company, Detroit, dealer in second hand railroad cars, for about \$250. The car was fitted with a four inch suction three inch discharge Snow Pump, (Buffalo) costing about \$120. Further, two one hundred foot lengths of two inch water hose and ten feet of steam hose and thirty-five feet of four inch wire line suction hose were purchased. A  $5/8$  inch nozzle was used. The steam goes through a pipe from the dome to either end of the engine with a valve at the end and a steam hose connection to the pump. When the pump is in operation it can throw two streams one hundred feet long or one stream for two hundred feet. From the nozzle the water is thrown 150 feet so the maximum distance for one stream would be 350 feet from the track. The whole equipment cost about \$600. It has proved its worth."

In a few cases several barrels of water in a couple of freight cars hauled by an engine with the proper hose attach-





Railroad right-of-way through state land where fires formerly did great damage. Connecticut.



Fire wardens of Simsbury and their equipment. 100 foot strip outside of right-of-way being cleared by burning. Connecticut.

ments has proved very effective. The freight cars can also be used to transport men, tools and supplies. A few barrels of water along the right-of-way where there is a heavy grade will also be very useful in putting out frequent fires which are apt to occur in such places.

Spring (1910) gives the following report on a bucket spray pump: "The bucket spray pump has been adopted for use in fighting fire and has proved very effective. In its use for fire fighting the pump is attached to a galvanized iron pail, the top of which is covered with burlap. A fire nozzle is substituted for the spray nozzle. Wherever water is available this method surpasses all others. It is useful also in controlling a back fire. In practice the man with the pump is followed by two or three men with hoes and shovels, to complete the extinguishing. Other laborers bring water. One bucketfull will put one hundred fifty to two hundred feet of fire. The water capacity of the pump is eight gallons."

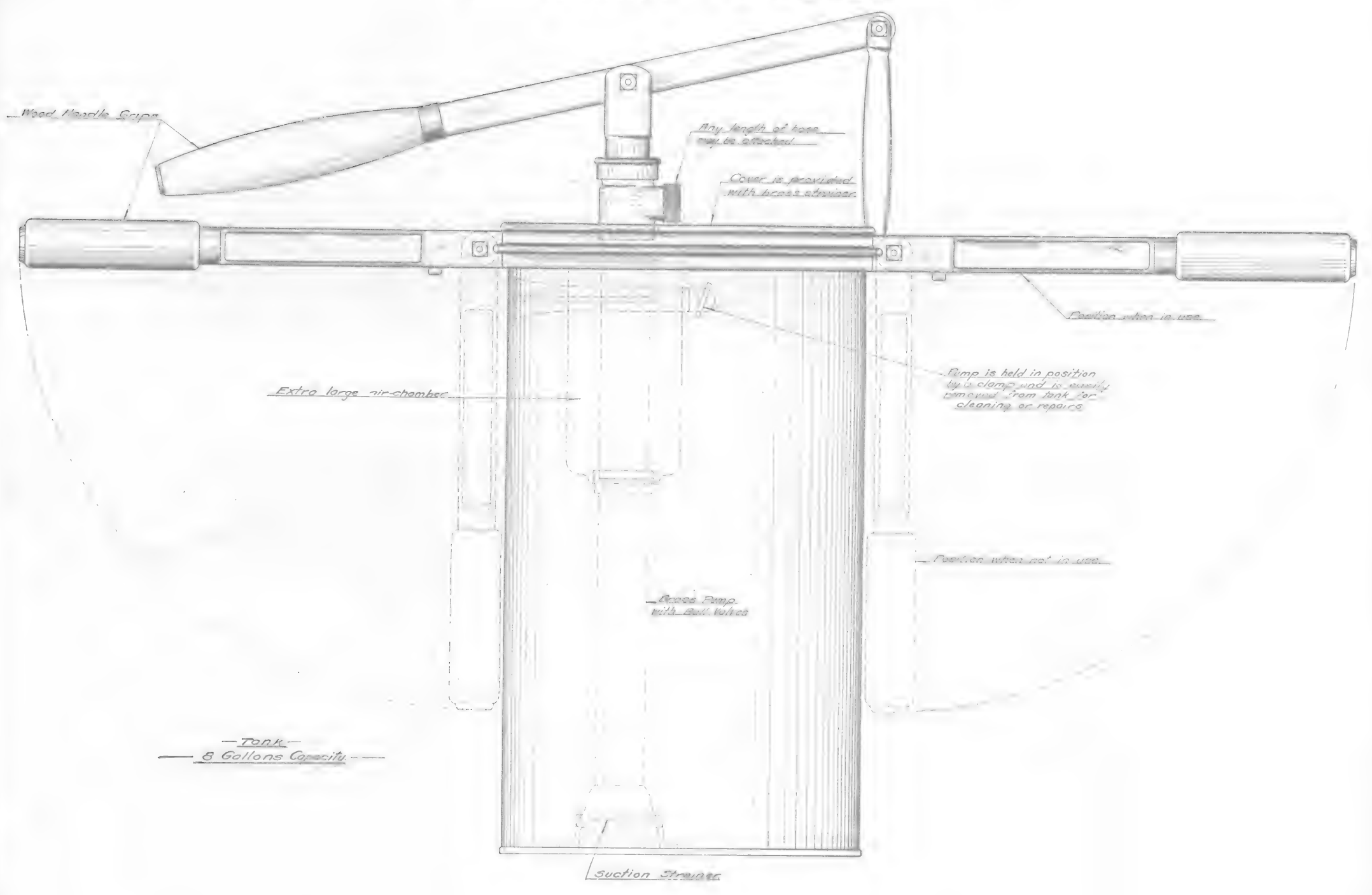
Wherever it is necessary the fire fighters can make fire lines. The methods of fire fighting vary in different parts of the country.

#### Instructions to Railroad Employees.

The railroad should furnish their train crews and section men with printed instructions concerning the state railroad forest fire laws and the regulations of the company in regard to the prevention and control of fires. Employees should be disciplined when they fail to follow the instructions by not keeping their locomotives or right-of-way in good



—“DOUBLE FORESTER”—



condition, or by failing to promptly report and extinguish fires.

Cooperation of Railroad With State and Individual.

The railroad should cooperate with the state and individual in trying to prevent and control railroad forest fires. The fire protection work of the Boston and Maine Railroad has been put under one office known as the Fire Claims Department. This centralizing of responsibility for all fire work has proved a most effective means of reducing damage. The success of the railroad depends upon the wealth of the country through which it passes. Forest fires make for a poor country.

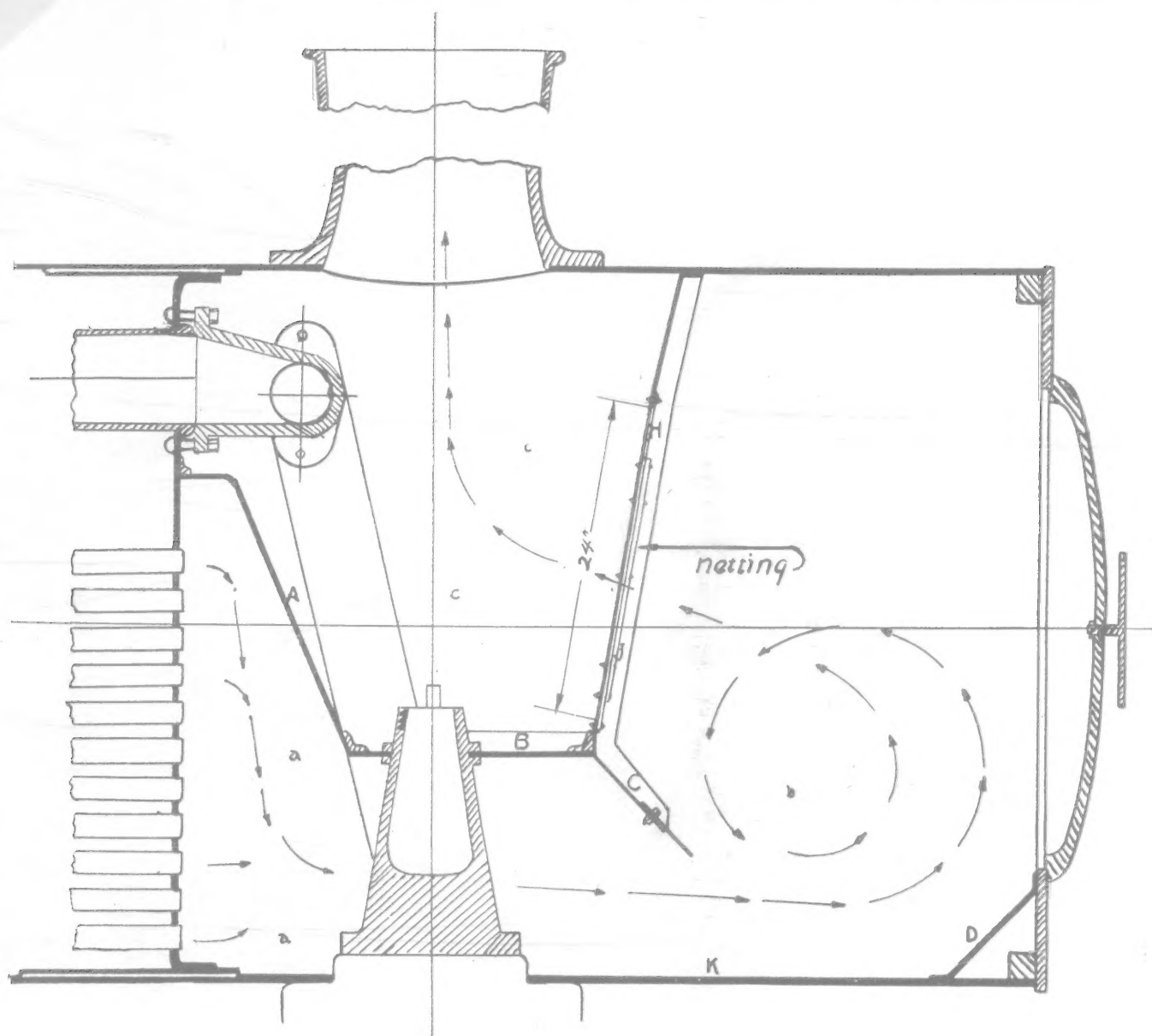


Sawmill conveyor and open burner in close proximity to green timber. Near Canadian Pacific Railway in British Columbia. The unregulated burning of sawmill debris has been known to cause serious forest fires.



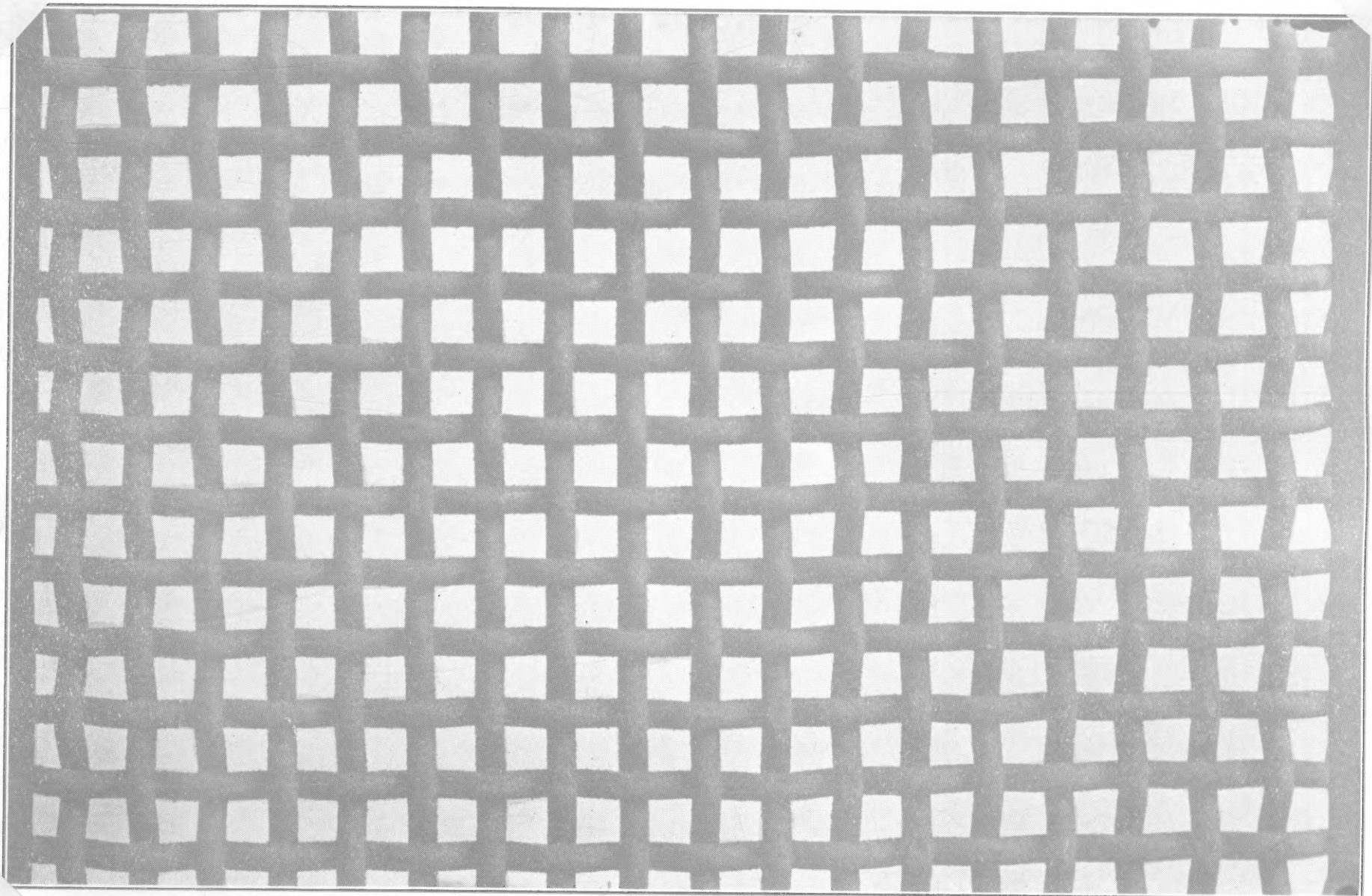
The results of a railroad fire. New Hampshire.





Side view—Accepted by the Forestry Department, State of Michigan as Standard "front end"  
 Mesh: 3-16 in. square opening No. 10 crimped wire. See page 35 and front view, preceding page.

#### THE RIGHT KIND OF MESH.



See and Northeastern Railway, spark arresting screen No. 10, steel wire, square mesh—3-16 accepted as standard under Department Inspection.

## BIBLIOGRAPHY

Allen (1911) Practical Forestry in Pacific Northwest.

Bristol (1912) Report of Society for Protection of New  
Hampshire Forests.

Cox (1913) Report of the Minnesota State Forester.

(1914) Report of the Minnesota State Forester.

Gaskill (1909) Report of the New Jersey Forest Commission.

Leavitt (1912) Forest Protection in Canada.

Recknagel (1906) Forestry Quarterly, Vol. IV, No. 1.

Ryder (1912) Report of Society for Protection of New  
Hampshire Forests.

Spring (1910) Report of Connecticut State Forester.

Also the Forest Fire Laws and Forestry Reports  
of the various states.



